

D) Investigation of at least one additional discrete crystal area by high-sensitivity resolution repetition of the process steps A) to C) on the specimen 3;

E) Mapping of the high-sensitivity resolution data measured on the specimen 3 in relation to the density and average extent of precipitated impurities in the crystal lattice of the monocrystalline material.

Yet another aspect of the invention is characterized by the fact that for the irradiation of the specimen 3, X-ray radiation in the wavelength range of about 0.02 nm to 0.003 nm is used, corresponding to photon energies of about 50 keV to 450 keV.

A further aspect of the invention is characterized by the fact that for the irradiation of the specimen 3, synchrotron radiation is used, and there is an energy dispersive detection of the dispersed radiation.

All, or substantially all, of the components and methods of the various embodiments may be used with at least one embodiment or all of the embodiments, if any, described herein.

All of the patents, patent applications and publications recited herein, if any, are hereby incorporated by reference as if set forth in their entirety herein.

The details in the patents, patent applications and publications may be considered to be incorporable, at applicant's option, into the claims during prosecution as further limitations in the claims to patentably distinguish any amended claims from any applied prior art.

The invention as described hereinabove in the context of the preferred embodiments is not to be taken as limited to all of the provided details thereof, since modifications and variations thereof may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Process for the inspection of monocrystalline material for precipitation of impurities, said process comprising the steps of:

- a) determining the orientation of the lattice planes of the monocrystalline material;
- b) directing an incident beam which is diffractable by the lattice planes of the monocrystalline material toward the monocrystalline material;
- c) disposing said incident beam and the lattice planes at an angle relative to one another to provide a reflected beam for a diffraction order of Bragg reflection from the lattice planes;
- d) orienting a detector, for measuring a Bragg reflection, and the lattice planes relative to one another to measure an intensity of said reflected beam of step c) for said diffraction order of Bragg reflection from the lattice planes;
- e) varying said angle of said incident beam over a plurality of angles with respect to the lattice planes in a plane, said plane defined by said plurality of incident beams and a plurality of reflected beams all lying in said plane, said plane being disposed to maintain substantially a sole orientation relative to the lattice planes;
- f) varying the orientation of said detector in substantially said plane between said detector and the lattice planes over said plurality of angles so that said detector measures said plurality of reflected beams of step e) to provide a plurality of measured reflections;
- g) integrating said plurality of measured reflections over said plurality of angles of the incident beam with respect to the lattice plane to determine an integral reflection factor;

h) varying an effective thickness of the monocrystalline material relative to the path of the incident and reflected beams by changing the orientation of said plane defined by said plurality of incident beams and said plurality of reflected beams with respect to the lattice planes, then repeating steps c) through g);

i) determining a Debye-Waller factor by fitting to a specified theoretical function, in which, with said Debye-Waller factor as a parameter, said integral reflection factor is calculated as a function of said effective thickness of the monocrystalline material;

j) performing at least one additional series of measurements, in which the steps c) through i) are repeated with at least one other diffraction order, and at least one other Debye-Waller factor is determined; and

k) evaluating said Debye-Waller factors as a function of said diffraction orders to determine an extent of precipitated impurities in the monocrystalline material.

2. Process according to claim 1, wherein steps a) through k) are repeated for at least one additional discrete crystal area of the monocrystalline material and mapping the data measured on the monocrystalline material in relation to the extent of precipitated impurities in the monocrystalline material.

3. Process according to claim 2, wherein said beam comprises X-ray radiation in the wavelength range of about 0.02 nm to 0.003 nm, corresponding to photon energies of about 50 keV to 450 keV.

4. Process according to claim 2, wherein said beam comprises synchrotron radiation, and said detector comprises a detector for energy dispersive detection of the dispersed radiation.

5. Process according to claim 3, wherein said lattice planes of the monocrystalline material being perpendicular to at least one surface of the monocrystalline material.

6. Process according to claim 5, wherein said varying of said angle of the incident beam over a plurality of angles with respect to the lattice planes in a plane, is accomplished by rotating the monocrystalline material about an axis being parallel to said lattice planes.

7. Process according to claim 6, wherein said axis is parallel to said at least one surface of the monocrystalline material being perpendicular to said lattice planes of the monocrystalline material.

8. Process according to claim 7, wherein said varying of said effective thickness of the monocrystalline material relative to the path of the incident and reflected beams is accomplished by rotating the monocrystalline material about an axis being perpendicular to said lattice planes and intersecting said axis being parallel to said lattice planes.

9. A Process for the inspection of monocrystalline material for precipitations of impurities, comprising:

- A) 1) Inspection of a first discrete crystal area of a monocrystalline specimen, said area being in the shape of a disc or platelet, by:
 - a) Measurement of an absolute reflection factor in a first diffraction order of Bragg reflection by lattice planes of the specimen, said lattice planes being perpendicular to the specimen surface, said measurement by means of an incident radiation beam and a photon or particle detector;
 - b) Rotation of the specimen around a first axis which runs perpendicular to a diffraction plane,